Computer Science at Oxford

Michael Spivey

Tutor, Oriel College

Department of
COMPUTER
SCIENCE

Computer Science at Oxford

- What's Computer Science about?
- The Oxford courses
- Four myths about Oxford

‘Russian’ multiplication

22	54

‘Russian’ multiplication

22	54
11	

‘Russian’ multiplication

22	54
11	
5	

‘Russian’ multiplication

22	54
11	
5	
2	

‘Russian’ multiplication

22	54
11	
5	
2	
1	

‘Russian’ multiplication

22	54
11	108
5	
2	
1	

‘Russian’ multiplication

22	54
11	108
5	216
2	
1	

‘Russian’ multiplication

22	54
11	108
5	216
2	432
1	

‘Russian’ multiplication

22	54
11	108
5	216
2	432
1	864

‘Russian’ multiplication

22	~~54~~
11	108
5	216
2	~~432~~
1	864

‘Russian’ multiplication

22	~~54~~
11	108
5	216
2	~~432~~
1	864
	———

‘Russian’ multiplication

22	~~54~~
11	108
5	216
2	~~432~~
1	864
	1 8

‘Russian’ multiplication

22	~~54~~
11	108
5	216
2	~~432~~
1	864
	88

‘Russian’ multiplication

22	~~54~~
11	108
5	216
2	~~432~~
1	864
	1188

Does it always work?

- Certainly for $22 \times 54 = 1188$.
- We've tried it for other examples too.
- But might there be one or two special numbers that make it go wrong?

Why does it work?

22	~~54~~
11	108
5	216
2	~~432~~
1	864

Why does it work?

22	~~54~~	0
11	108	
5	216	
2	~~432~~	
1	864	

Why does it work?

22	~~54~~	0
11	108	0
5	216	
2	~~432~~	
1	864	

Why does it work?

22	~~54~~	0
11	108	0
5	216	108
2	~~432~~	
1	864	

Why does it work?

22	~~54~~	0
11	108	0
5	216	108
2	~~432~~	324
1	864	

Why does it work?

22	~~54~~	0
11	108	0
5	216	108
2	~~432~~	324
1	864	324

Why does it work?

22	~~54~~	0
11	108	0
5	216	108
2	~~432~~	324
1	864	324
0		

Why does it work?

22	~~54~~	0
11	108	0
5	216	108
2	~~432~~	324
1	864	324
0	1728	

Why does it work?

22	~~54~~	0
11	108	0
5	216	108
2	~~432~~	324
1	864	324
0	1728	1188

Why does it work?

$22 \times 54 = 11 \times 108$?

22	~~54~~	0
11	108	0
5	216	108
2	~~432~~	324
1	864	324
0	1728	1188

Why does it work?

$22 \times 54 = 11 \times 108$

$= 5 \times 216$?

22	~~54~~	0
11	108	0
5	216	108
2	~~432~~	324
1	864	324
0	1728	1188

Why does it work?

$$22 \times 54 = 11 \times 108$$

$$= 5 \times 216 + 108$$

22	~~54~~	0
11	108	0
5	216	108
2	~~432~~	324
1	864	324
0	1728	1188

Why does it work?

$$22 \times 54 = 11 \times 108$$

$$= 5 \times 216 + 108$$

$$= 2 \times 432 \ ?$$

22	~~54~~	0
11	108	0
5	216	108
2	~~432~~	324
1	864	324
0	1728	1188

Why does it work?

$$22 \times 54 = 11 \times 108$$

$$= 5 \times 216 + 108$$

$$= 2 \times 432 + 216 + 108$$

22	~~54~~	0
11	108	0
5	216	108
2	~~432~~	324
1	864	324
0	1728	1188

Why does it work?

$$22 \times 54 = 11 \times 108$$

$$= 5 \times 216 + 108$$

$$= 2 \times 432 + 324$$

22	~~54~~	0
11	108	0
5	216	108
2	~~432~~	324
1	864	324
0	1728	1188

Why does it work?

$$22 \times 54 = 11 \times 108$$

$$= 5 \times 216 + 108$$

$$= 2 \times 432 + 324$$

$$= 1 \times 864 + 324$$

22	~~54~~	0
11	108	0
5	216	108
2	~~432~~	324
1	864	324
0	1728	1188

Why does it work?

$$22 \times 54 = 11 \times 108$$

$$= 5 \times 216 + 108$$

$$= 2 \times 432 + 324$$

$$= 1 \times 864 + 324$$

$$= 0 \times 1728 + 1188$$

22	~~54~~	0
11	108	0
5	216	108
2	~~432~~	324
1	864	324
0	1728	1188

Why does it work?

$$22 \times 54 = 11 \times 108$$

$$= 5 \times 216 + 108$$

$$= 2 \times 432 + 324$$

$$= 1 \times 864 + 324$$

$$= 0 \times 1728 + 1188$$

$$= 1188$$

22	~~54~~	0
11	108	0
5	216	108
2	~~432~~	324
1	864	324
0	1728	1188

Writing down the rules

1. Start with the two numbers to be multiplied in columns x and y, and 0 in column z.

2. Repeat until 0 appears in column x:
   - if x is odd, replace z by $y + z$.
   - replace x by $x \div 2$ and y by $2 \times y$.

3. The answer appears in column z.

Writing it as a computer program

$x := a;\ \ y := b;\ \ z := 0;$

while $x \neq 0$ **do**

    if $ODD(x)$ **then** $z := y + z$ **end**;

    $x := x \div 2;\ \ y := 2 \times y$

end;

return z

Hang on a minute!

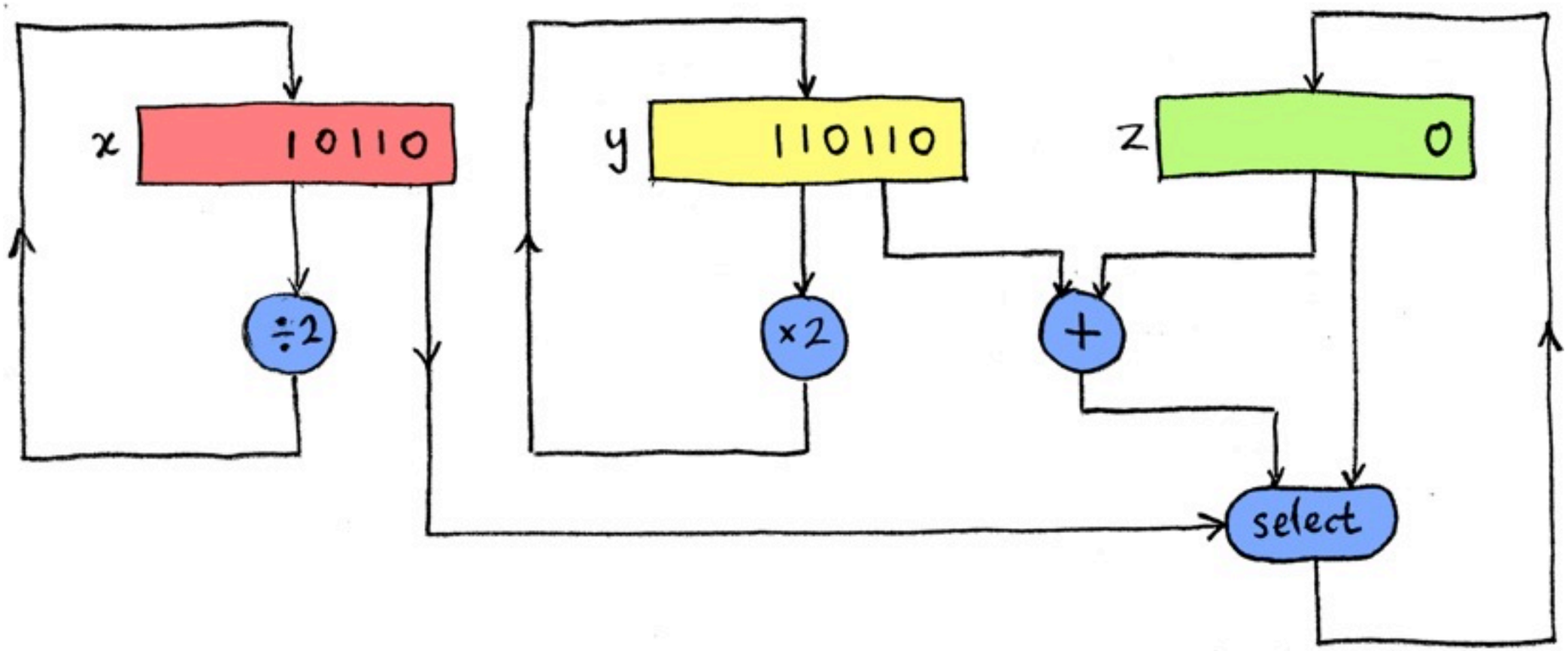
Why not just use this program:

$$\textbf{return } a \times b$$

and have the multiplication done by an electronic circuit in the computer?

Come to think of it, how do we know that computers and calculators always get the right answer for multiplication?

A multiplication circuit



Computer science

- It's *not* about learning new programming languages.
- It *is* about understanding why programs work, and how to design them.